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*Idaho National Engineering Laboratory*

# A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1952–1983

## Volume 1

*Lockheed Idaho Technologies Company*

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## Volume 1

Published August 1995

Idaho National Engineering Laboratory
Lockheed Idaho Technologies Company
Idaho Falls, Idaho 83415

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## PREFACE

This report, *A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1952–1983*, is comprised of five volumes. Volume 1 consists of the main body of the report and Appendices A, C, D, E, F, and G. Appendix B, the complete printout of the inventory database, is provided in Volumes 2 through 5. Because of its size, distribution of Appendix B has been limited. A copy of the volumes containing Appendix B can be provided on request.

# ABSTRACT

This report presents a comprehensive inventory of the radiological and nonradiological contaminants in waste buried from 1952 through 1983 at the Radioactive Waste Management Complex (RWMC) of the Idaho National Engineering Laboratory. The project to compile the inventory is referred to as the historical data task. The inventory was compiled primarily for use in a baseline risk assessment under the Comprehensive Environmental Response, Compensation, and Liability Act. The compiled information may also be useful for environmental remediation activities that might be necessary at the RWMC. The information that was compiled has been entered into the Contaminant Inventory Database for Risk Assessment (CIDRA).

The inventory information was organized according to waste generator and divided into waste streams for each generator. Waste information available in facility operating records, technical and programmatic reports, shipping records, and databases was included in the inventory. Additional information was obtained by reviewing the plant operations that originally generated the waste, interviewing personnel formerly employed as operators, and performing nuclear physics and engineering calculations. In addition to contaminant inventories, information was compiled on the physical and chemical characteristics and the packaging of the 234 waste streams.

The contaminant inventories were developed in the form of best estimates. Upper and lower bounds were also formulated by evaluating the methods by which contaminant quantities were estimated.

The completeness of the contaminant inventories was confirmed by comparing them against inventories in previous reports and in other databases, and against the list of contaminants detected in environmental monitoring performed at the RWMC.

A companion report to this report, *A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1984–2003*, INEL-95/0135, Lockheed Idaho Technologies Company, August 1995, covers waste buried or projected to be buried at the Subsurface Disposal Area during the years 1984 through 2003. The methodologies used in the two reports are essentially identical. Taken together, the two reports encompass the waste buried or projected to be buried in the Subsurface Disposal Area from 1952 through 2003.

## ACKNOWLEDGMENTS

The efforts of many people were required to compile the contaminant inventory presented in this report and to develop the Contaminant Inventory Database for Risk Assessment database. The contributions of these people are gratefully acknowledged. The principal contributors were

| | | |
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| Comparisons Against Other Documents and Databases | Donald E. Kudera<br>Patrick R. Leonard<br>Donald W. Rhodes<br>Thomas H. Smith |
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# EXECUTIVE SUMMARY

## Introduction and Background

This report documents the compilation of a comprehensive inventory of radiological and nonradiological contaminants in waste buried in the Subsurface Disposal Area (SDA) at the Radioactive Waste Management Complex (RWMC) of the Idaho National Engineering Laboratory (INEL). The inventory was compiled primarily for use in a baseline risk assessment (BRA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The project to compile the inventory is referred to as the historical data task (HDT).

The RWMC, located in the southwest portion of the INEL, is a solid radioactive waste disposal site. It consists of the 38.85-ha (96-acre) SDA, the 22.7-ha (56-acre) Transuranic Storage Area, and the Administrative Area.

The inventory covers the waste buried from the opening of the SDA in 1952 through 1983. The SDA disposal units covered in this report include the transuranic (TRU) contaminated pits and trenches, non-TRU contaminated pits and trenches, Acid Pit, Pad A, and soil vault rows open during the period of interest. For completeness, the inventory also includes the waste disposed of in Pit 9. This disposal unit may be addressed separately under CERCLA; therefore, the Pit 9 inventory may be subtracted later from the total inventory.

Waste in the Transuranic Storage Area is not included in this inventory because it is stored aboveground. Waste disposed of in the SDA after 1983 is excluded because it is currently considered part of active disposal operations and is covered in a companion report (*A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried or Projected to be Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1984–2003*).

The inventory addresses radioactive waste, hazardous substances per CERCLA (which encompass hazardous waste per the Resource Conservation and Recovery Act), and mixed waste.

This task built upon the inventories in previous reports and databases by adding several types of additional information that are needed for the BRA:

- A more comprehensive inventory of nonradiological contaminants
- Identification of specific radionuclides previously listed under generic names [e.g., mixed fission products (MFP) or mixed activation products (MAP)]
- Physical and chemical forms of the contaminants and of the host waste streams
- Uncertainties in the contaminant quantities.

This inventory was compiled pursuant to regulations and agreements related to CERCLA. A Federal Facility Agreement and Consent Order (FFA/CO) for the INEL was signed by the U.S. Department of Energy, U.S. Environmental Protection Agency, and State of Idaho Department of

Health and Welfare to protect human health and the environment. One of the INEL waste area groups (WAGs) defined under the FFA/CO is WAG-7, the RWMC.

Under the CERCLA implementing regulations of 40 Code of Federal Regulations (CFR) 300.430 (d)(2), the lead agency is required to "characterize the nature of and threat posed by the hazardous substances and hazardous materials and gather data necessary to assess the extent to which the release poses a threat to human health or the environment . . ." The information collected is to cover ". . . the general characteristics of the waste, including quantities, state, concentration, toxicity, propensity to bioaccumulate, persistence, and mobility" and "the extent to which the source can be adequately identified and characterized."

Per guidance in the National Contingency Plan under CERCLA, a human health BRA will be performed for the SDA. The inventory developed here and in the companion report will be used to help determine the source term for the BRA.

In addition to helping determine the BRA source term, the inventory information compiled here has other potential uses. Examples are evaluating remedial alternatives (should remediation be required), assessing health and safety hazards to workers, and identifying potential operational problems.

## Methodology for Data Collection and Compilation

### The Challenge

The approach for compiling the inventory information had to reflect the complex nature of waste disposal at the SDA. When disposal at the SDA began 43 years ago, requirements and practices did not include the current requirements for waste characterization, so complete information about the waste was not obtained when it was generated and disposed of.

The disposal area is large and the waste is varied; therefore, drilling and sampling and analysis of the samples to determine the contaminant inventory is not feasible. Even a massive drilling and sampling campaign would not result in an inventory in which high confidence could be placed because of the heterogeneity of the waste.

Information and inventories of the waste buried in the SDA have been compiled in previous efforts for various uses. Some of the compilations have been entered into databases, such as the Radioactive Waste Management Information System (RWMIS). The previous compilations contain useful information, but they have limitations. For example, RWMIS problems include the following. For waste shipments before 1960, RWMIS has shipping record entries for only the Rocky Flats Plant (RFP) waste, and those entries generally provide no quantitative information concerning the contaminants. Some textual descriptions are generic (e.g., plant waste) and do not provide insight into the actual contents of the waste. RWMIS contains very little information concerning nonradiological contaminants in the waste. The radionuclide listings in RWMIS have problems, such as (a) entries with only one radionuclide identified (e.g., Pu-239) although knowledge of the waste-generating process indicates that other radionuclides must also be present, (b) entries with only the element specified (e.g., uranium) with no designation of a particular radionuclide, (c) entries with only generic radioactivity terms MAP and/or MFP identified, with no designation of particular radionuclides, and (d) entries with only one fission product identified (e.g., Cs-137) although others must also be present.

Most previous compilations were derived solely from shipping records. Many addressed only the radiological contaminants in the waste. It was concluded that the existing compilations, though very useful, were not adequate to support the BRA.

### The Approach

A different approach to compile the inventory information was devised. The approach emphasizes the use of information about the processes that generated the waste, supplemented by information from reports, shipping records, databases, and nuclear physics calculations. First, the facilities that generated the SDA waste were divided into seven groups, as follows: Test Area North (TAN), Test Reactor Area (TRA), Idaho Chemical Processing Plant (ICPP), Naval Reactors Facility (NRF), Argonne National Laboratory—West (ANL-W), RFP, and "other" generators (this designation includes all other onsite facilities, all other offsite facilities, and decontamination and decommissioning programs). Seven lead data gatherers were then appointed to direct the compilation of information on the waste from the seven generators. In nearly every case, the lead data gatherers had worked at the waste generator location where they collected data, and they were familiar with the operational activities that generated the waste.

Figure S-1 depicts the flow of information in this approach. The rectangles represent items of information, and the ovals represent technical activities performed with the information. Several sources of information were used by the data gatherers: process knowledge and plant operating records, inventory and other technical reports, engineering and nuclear physics calculations, shipping and disposal records (and databases of the records), interviews with plant employees (including retired employees), and other records. For each of the waste generators, varying uses were made of these sources, depending on the availability of the information and the nature of the waste.

The waste from a generator was subdivided into several waste streams. Basically, a waste stream was defined so as to reduce the nonhomogeneity within the stream. For example, one stream consisted of all of the beryllium reflectors from TRA.

A standardized, five-page data form was used to record the information for each of the 234 identified waste streams. The form requested the following information: the waste generator, building, and assigned number of the waste stream from that building; the volume, physical and chemical form, and containment of the waste stream; the quantities (including uncertainties) and the physical and chemical form of the nonradiological and radiological contaminants in the waste stream; the source(s) and reliability of the information; and the assumptions made in dealing with the waste stream.

After the information was entered onto data forms, it was subjected to qualification as shown in Figure S-1 and entered into the new Contaminant Inventory Database for Risk Assessment (CIDRA).

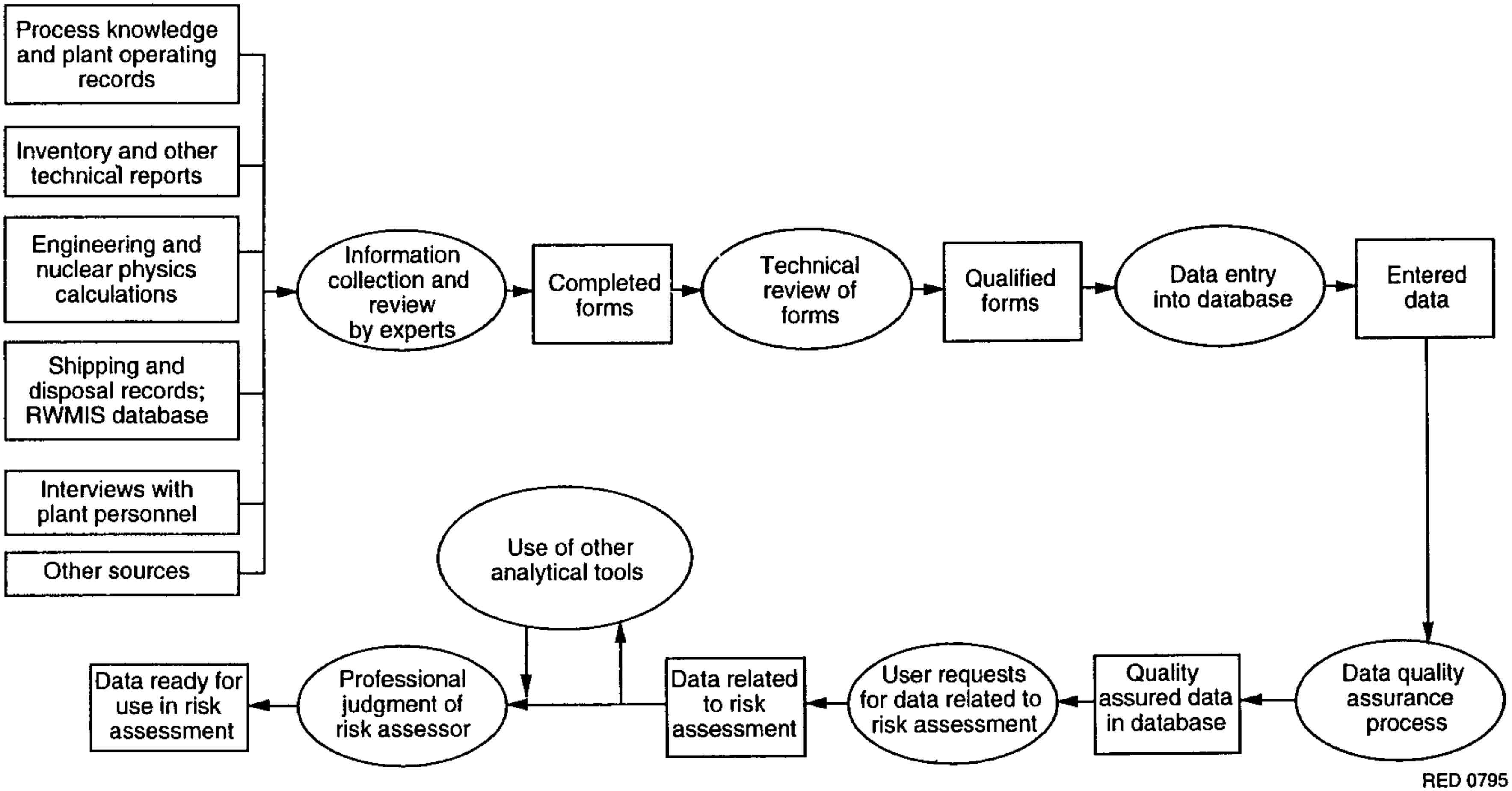


**Figure S-1.** Approach for information flow in developing the inventory.

## Results

Appendix B to this report, in four separate volumes, contains a complete printout of the information in the CIDRA database.

Tables S-1 and S-2 list the total best-estimate quantities of each contaminant, covering all waste streams from all generators. Upper and lower bounds are also given. Table S-1 lists the nonradiological contaminants, in terms of grams. Table S-2 lists the radiological contaminants, in terms of curies at the time of disposal. Similar tables are presented in this report for each waste generator.

All inventories in this report are given to only two significant digits. Specifying more significant digits would give an erroneous impression of the accuracy inherent in the inventories.

The uncertainties in the contaminant inventory were evaluated as follows. Best estimates of the annual quantities of each contaminant for each waste stream were made by the data gatherers. Upper and lower bounds, analogous to 95% confidence limits, accompany the best estimates. When possible, the bounds are based on actual measurements and on the experience and knowledge of the data gatherers. When not possible, generic error bounds were constructed by propagating known biases and expected uncertainties. Using standard statistical techniques, the errors in annual quantities for individual waste streams were propagated to obtain upper and lower bounds on the total quantity for each contaminant. This error-propagation procedure is programmed into CIDRA.

A major bias in many of the waste records is due to the use of the Geiger-Müller (G-M) counter survey method to estimate the quantities of radiological contaminants in the waste containers. Radioactivity data believed to have been obtained by this method were corrected in the CIDRA inventory. The correction was based on extensive study of the results of previous evaluations on the accuracy of that method, using laboratory mockups and actual waste containers. The correction is a downward revision by a factor of two for the affected contaminants and waste streams.

A major source of uncertainty is due to the use of scaling factors for estimating radionuclide distributions. A scaling factor is a fraction or percentage representing the activity of one radionuclide relative to the activity of another radionuclide or to the total activity of a group of radionuclides. Scaling factor uncertainties were estimated empirically using a large data set containing the activities of several radionuclides for several waste streams.

Several nonradiological contaminants were identified for which no defendable estimates of the quantities were possible. For these contaminants, rough, upper-limit estimates were developed where feasible. The results of such evaluations are reported separately and do not appear in Table S-1.

**Table S-1.** Inventory of nonradiological contaminants (listed alphabetically) from all generators.

| CAS number[a] | Chemical | Best estimate (g) | Lower bound | Upper bound |
|---|---|---|---|---|
| 71-55-6 | 1,1,1-trichloroethane | 1.1E+08 | 9.5E+07 | 1.2E+08 |
| 76131 | 1,1,2-trichloro-1,2,2-trifluoroethane | 9.1E+06 | 8.5E+06 | 9.8E+06 |
| 1806-34-4 | 1,4-bis(5-phenyloxazol-2-YL)benzene | Unknown | NA[b] | NA |
| 78-93-3 | 2-butanone | 3.2E+04 | 2.5E+04 | 4.0E+04 |
| 56-49-5 | 3-methylcholanthrene | Unknown | NA | NA |
| 67-64-1 | Acetone | 1.1E+05 | 9.8E+04 | 1.3E+05 |
| — | Alcohols | Unknown | NA | NA |
| 7784-27-2 | Aluminum nitrate nonahydrate | 1.9E+08 | 1.5E+08 | 2.4E+08 |
| 7664417 | Ammonia | 7.8E+05 | 2.7E+05 | 1.8E+06 |
| 120-12-7 | Anthracene | 2.0E+02 | 7.0E+01 | 4.6E+02 |
| 7440-36-0 | Antimony | 4.5E+02 | 1.6E+02 | 1.0E+03 |
| — | Aqua regia | 3.1E+01 | 3.0E+01 | 3.2E+01 |
| 1332-21-4 | Asbestos | 1.2E+06 | 4.7E+05 | 2.6E+06 |
| 71-43-2 | Benzene | Unknown | NA | NA |
| 8032-32-4 | Benzine | 4.0E+03 | 3.3E+03 | 4.8E+03 |
| 7440-41-7 | Beryllium | 1.5E+07 | 1.4E+07 | 1.6E+07 |
| 1304-56-9 | Beryllium oxide | Unknown | NA | NA |
| 71363 | Butyl alcohol | 9.9E+04 | 9.0E+04 | 1.1E+05 |
| 7440-43-9 | Cadmium | 1.6E+06 | 9.2E+05 | 2.5E+06 |
| 56-23-5 | Carbon tetrachloride | 1.2E+08 | 1.1E+08 | 1.4E+08 |
| 7790-86-5 | Cerium chloride | 5.1E+05 | 4.2E+05 | 6.2E+05 |
| 67-66-3 | Chloroform | 3.7E+01 | 3.6E+01 | 3.7E+01 |
| 7440-47-3 | Chromium | 1.0E+03 | 6.8E+02 | 1.5E+03 |
| 7440-50-8 | Copper | Unknown | NA | NA |
| 3251-23-8 | Copper nitrate | 3.3E+02 | 2.6E+02 | 4.1E+02 |
| — | Cyanide | Unknown | NA | NA |
| — | Dibutylethylcarbutol | Unknown | NA | NA |
| 55914 | Diisopropylfluorophosphate | Unknown | NA | NA |

Table S-1. (continued).

| CAS number[a] | Chemical | Best estimate (g) | Lower bound | Upper bound |
|---|---|---|---|---|
| 60-29-7 | Ether | Unknown | NA | NA |
| 64175 | Ethyl alcohol | 2.2E+04 | 1.8E+04 | 2.8E+04 |
| 50-00-0 | Formaldehyde | 1.4E+05 | 1.3E+05 | 1.5E+05 |
| 302012 | Hydrazine | 1.8E+03 | 1.3E+03 | 2.3E+03 |
| 7664393 | Hydrofluoric acid | 7.6E+06 | 6.0E+06 | 9.6E+06 |
| 7439-92-1 | Lead | 5.8E+08 | 4.9E+08 | 6.8E+08 |
| 7580-67-8 | Lithium hydride | Unknown | NA | NA |
| 12057-24-8 | Lithium oxide | Unknown | NA | NA |
| 7439-95-4 | Magnesium | 9.0E+06 | 7.4E+06 | 1.1E+07 |
| 7783-40-6 | Magnesium fluoride | 1.4E+05 | 1.3E+05 | 1.4E+05 |
| 1309-48-4 | Magnesium oxide | Unknown | NA | NA |
| 7439-96-5 | Manganese | Unknown | NA | NA |
| 7439-97-6 | Mercury | Unknown | NA | NA |
| 7783-34-8 | Mercury nitrate monohydrate | 8.1E+05 | 6.3E+05 | 1.0E+06 |
| 67-56-1 | Methyl alcohol | 2.2E+05 | 2.0E+05 | 2.5E+05 |
| 108-10-1 | Methyl isobutyl ketone | 8.9E+06 | 7.0E+06 | 1.1E+07 |
| 75-09-2 | Methylene chloride | 1.4E+07 | 1.4E+07 | 1.5E+07 |
| 7440-02-0 | Nickel | 2.2E+03 | 1.0E+03 | 4.1E+03 |
| 7697-37-2 | Nitric acid | 5.0E+07 | 3.9E+07 | 6.2E+07 |
| 4165-60-0 | Nitrobenzene | Unknown | NA | NA |
| — | Nitrocellulose | Unknown | NA | NA |
| — | Organic acids | Unknown | NA | NA |
| — | Organophosphates | Unknown | NA | NA |
| 1336363 | PCB | Unknown | NA | NA |
| 7447-40-7 | Potassium chloride | 8.0E+07 | 5.9E+07 | 1.1E+08 |
| 7778-50-9 | Potassium dichromate | 2.3E+06 | 1.7E+06 | 3.0E+06 |
| 7757-79-1 | Potassium nitrate | 1.8E+09 | 1.3E+09 | 2.4E+09 |

**Table S-1.** (continued).

| CAS number[a] | Chemical | Best estimate (g) | Lower bound | Upper bound |
|---|---|---|---|---|
| 7778-77-0 | Potassium phosphate | 4.0E+07 | 3.0E+07 | 5.4E+07 |
| 7778-80-5 | Potassium sulfate | 8.0E+07 | 5.9E+07 | 1.1E+08 |
| 7440-22-4 | Silver | 5.9E+03 | 4.7E+03 | 7.3E+03 |
| 7440-23-5 | Sodium | 6.8E+04 | 6.1E+04 | 7.5E+04 |
| 7647-14-5 | Sodium chloride | 1.6E+08 | 1.2E+08 | 2.1E+08 |
| 143-33-9 | Sodium cyanide | 9.4E+02 | 3.2E+02 | 2.2E+03 |
| 10588-01-9 | Sodium dichromate | 4.1E+06 | 3.0E+06 | 5.4E+06 |
| 1310-73-2 | Sodium hydroxide | 1.5E+02 | 5.1E+01 | 3.4E+02 |
| 7631-99-4 | Sodium nitrate | 1.2E+09 | 8.4E+08 | 1.6E+09 |
| 10101-89-0 | Sodium phosphate | 8.0E+07 | 5.9E+07 | 1.1E+08 |
| 11135-81-2 | Sodium potassium | 1.7E+06 | 1.2E+06 | 2.4E+06 |
| 7757-82-6 | Sodium sulfate | 1.6E+08 | 1.2E+08 | 2.1E+08 |
| 7664-93-9 | Sulfuric acid | 1.2E+05 | 9.9E+04 | 1.5E+05 |
| 26140-60-3 | Terphenyl | 4.5E+05 | 1.6E+05 | 1.0E+06 |
| 127-18-4 | Tetrachloroethylene | 2.7E+07 | 2.3E+07 | 3.1E+07 |
| 108-88-3 | Toluene | 1.9E+05 | 1.3E+05 | 2.6E+05 |
| 126-73-8 | Tributyl phosphate | 1.0E+06 | 7.8E+05 | 1.3E+06 |
| 79-01-6 | Trichloroethylene | 1.0E+08 | 9.1E+07 | 1.2E+08 |
| 15625-89-5 | Trimethylolpropane-triester | 1.2E+06 | 8.4E+05 | 1.6E+06 |
| 10102064 | Uranyl nitrate | 2.2E+05 | 1.7E+05 | 2.8E+05 |
| — | Versenes | Unknown | NA | NA |
| 1330-20-7 | Xylene | 8.5E+05 | 7.2E+05 | 1.0E+06 |
| 7440-67-7 | Zirconium | 1.9E+07 | 1.6E+07 | 2.3E+07 |
| — | Zirconium alloys | 5.9E+06 | 4.7E+06 | 7.3E+06 |

a. CAS—Chemical Abstract Services.

b. NA—not applicable.

**Table S-2.** Inventory of radiological contaminants (listed alphabetically) from all generators (activity at time of disposal).

| Radionuclide | Best estimate (Ci) | Percent of total (%) | Lower bound | Upper bound |
|---|---|---|---|---|
| Ag-110 | 8.4E-01 | <0.05 | 4.6E-03 | 6.1E+00 |
| Am-241 | 1.5E+05 | 1.3 | 1.1E+05 | 2.0E+05 |
| Am-242 | 7.6E-03 | <0.05 | 4.0E-05 | 5.5E-02 |
| Am-243 | 2.3E-01 | <0.05 | 2.4E-03 | 1.6E+00 |
| Ba-133 | 5.4E-04 | <0.05 | 2.8E-06 | 3.9E-03 |
| Ba-137m | 3.4E+00 | <0.05 | 1.6E-02 | 2.4E+01 |
| Ba-140 | 6.6E+02 | <0.05 | 2.8E+01 | 3.6E+03 |
| Be-10 | 4.3E+01 | <0.05 | 2.9E-01 | 3.1E+02 |
| Be-7 | 3.5E-01 | <0.05 | 7.1E-03 | 2.2E+00 |
| C-14 | 1.6E+04 | 0.1 | 7.8E+02 | 8.5E+04 |
| Ca-45 | 6.7E-04 | <0.05 | 3.2E-06 | 4.8E-03 |
| Cd-104 | 1.5E-07 | <0.05 | 3.0E-09 | 9.5E-07 |
| Cd-109 | 4.1E-01 | <0.05 | 1.1E-02 | 2.5E+00 |
| Ce-141 | 7.6E+02 | <0.05 | 3.7E+01 | 4.0E+03 |
| Ce-144 | 1.5E+05 | 1.3 | 2.6E+04 | 5.2E+05 |
| Cf-252 | 1.0E-02 | <0.05 | 9.8E-05 | 6.9E-02 |
| Cl-36 | 3.1E-01 | <0.05 | 3.1E-03 | 2.2E+00 |
| Cm-242 | 9.1E+01 | <0.05 | 1.2E+01 | 3.4E+02 |
| Cm-244 | 8.0E+01 | <0.05 | 4.9E+00 | 4.0E+02 |
| Co-57 | 4.8E+00 | <0.05 | 9.6E-02 | 3.0E+01 |
| Co-58 | 1.6E+05 | 1.3 | 4.7E+04 | 4.0E+05 |
| Co-60 | 2.8E+06 | 23.8 | 2.2E+06 | 3.7E+06 |
| Cr-51 | 7.3E+05 | 6.1 | 1.6E+04 | 4.5E+06 |
| Cs-134 | 2.2E+03 | <0.05 | 3.7E+02 | 7.4E+03 |
| Cs-136 | 7.7E-01 | <0.05 | 2.6E-02 | 4.4E+00 |
| Cs-137 | 7.0E+05 | 5.8 | 4.9E+05 | 9.5E+05 |
| Er-169 | 7.6E-03 | <0.05 | 7.4E-05 | 5.3E-02 |

**Table S-2.** (continued).

| Radionuclide | Best estimate (Ci) | Percent of total (%) | Lower bound | Upper bound |
|---|---|---|---|---|
| Eu-152 | 2.4E+02 | <0.05 | 2.1E+02 | 2.6E+02 |
| Eu-154 | 3.0E+03 | <0.05 | 8.8E+01 | 1.7E+04 |
| Eu-155 | 1.5E+04 | 0.1 | 7.9E+02 | 7.6E+04 |
| Fe-55 | 3.8E+06 | 31.5 | 2.2E+06 | 6.0E+06 |
| Fe-59 | 9.1E+04 | 0.8 | 2.0E+03 | 5.6E+05 |
| H-3 | 1.2E+06 | 9.8 | 7.5E+05 | 1.8E+06 |
| Hf-181 | 3.6E-01 | <0.05 | 3.0E-03 | 2.6E+00 |
| Hg-203 | 1.2E-02 | <0.05 | 5.8E-05 | 8.7E-02 |
| I-125 | 2.9E-02 | <0.05 | 5.9E-04 | 1.8E-01 |
| I-129 | 9.9E-02 | <0.05 | 6.2E-03 | 4.8E-01 |
| I-131 | 1.5E+00 | <0.05 | 8.2E-03 | 1.1E+01 |
| I-133 | 5.0E-02 | <0.05 | 2.5E-04 | 3.6E-01 |
| Ir-192 | 5.4E+01 | <0.05 | 1.4E+00 | 3.2E+02 |
| Kr-85 | 1.3E+00 | <0.05 | 6.2E-03 | 9.5E+00 |
| La-140 | 7.7E+02 | <0.05 | 3.2E+01 | 4.2E+03 |
| Mn-53 | 1.0E-03 | <0.05 | 2.0E-05 | 6.3E-03 |
| Mn-54 | 1.8E+05 | 1.5 | 3.7E+04 | 5.4E+05 |
| Mn-56 | 2.7E+01 | <0.05 | 1.6E-01 | 2.0E+02 |
| Mo-99 | 1.0E+00 | <0.05 | 1.5E-02 | 6.6E+00 |
| Na-22 | 3.0E-01 | <0.05 | 5.4E-03 | 2.0E+00 |
| Nb-94 | 4.9E+01 | <0.05 | 2.5E+01 | 8.8E+01 |
| Nb-95 | 2.4E+03 | <0.05 | 1.4E+03 | 3.9E+03 |
| Ni-59 | 5.1E+03 | <0.05 | 2.4E+02 | 2.7E+04 |
| Ni-63 | 7.4E+05 | 6.2 | 4.7E+05 | 1.1E+06 |
| Np-237 | 2.4E+00 | <0.05 | 1.7E-01 | 1.1E+01 |
| P-32 | 9.2E-02 | <0.05 | 1.4E-03 | 6.1E-01 |
| Pb-210 | 9.1E-06 | <0.05 | 1.8E-07 | 5.7E-05 |

**Table S-2.** (continued).

| Radionuclide | Best estimate (Ci) | Percent of total (%) | Lower bound | Upper bound |
|---|---|---|---|---|
| Pb-212 | 2.0E-05 | <0.05 | 4.0E-07 | 1.3E-04 |
| Pm-147 | 8.1E+01 | <0.05 | 9.6E-01 | 5.5E+02 |
| Po-210 | 7.5E+01 | <0.05 | 1.4E+00 | 4.8E+02 |
| Pr-143 | 6.2E+02 | <0.05 | 2.1E+01 | 3.6E+03 |
| Pr-144 | 4.2E+04 | 0.4 | 3.2E+03 | 1.9E+05 |
| Pu-238 | 2.5E+03 | <0.05 | 4.3E+02 | 8.6E+03 |
| Pu-239 | 6.6E+04 | 0.5 | 4.7E+04 | 8.9E+04 |
| Pu-240 | 1.5E+04 | 0.1 | 1.0E+04 | 2.2E+04 |
| Pu-241 | 4.0E+05 | 3.3 | 2.9E+05 | 5.4E+05 |
| Pu-242 | 9.9E-01 | <0.05 | 7.3E-01 | 1.3E+00 |
| Ra-225 | 2.0E-06 | <0.05 | 1.5E-06 | 2.5E-06 |
| Ra-226 | 5.9E+01 | <0.05 | 4.4E+01 | 7.6E+01 |
| Rb-86 | 7.1E+00 | <0.05 | 1.1E-01 | 4.6E+01 |
| Rh-103m | 2.7E+02 | <0.05 | 9.2E+00 | 1.5E+03 |
| Rh-106 | 6.8E+03 | <0.05 | 5.0E+03 | 9.0E+03 |
| Rn-222 | 1.0E-06 | <0.05 | 2.0E-08 | 6.3E-06 |
| Ru-103 | 3.6E+02 | <0.05 | 1.5E+01 | 1.9E+03 |
| Ru-106 | 6.8E+03 | <0.05 | 5.0E+03 | 9.0E+03 |
| S-35 | 8.8E-02 | <0.05 | 1.6E-03 | 5.6E-01 |
| Sb-124 | 1.8E+03 | <0.05 | 1.0E+01 | 1.3E+04 |
| Sb-125 | 1.3E+05 | 1.1 | 1.1E+05 | 1.4E+05 |
| Sc-44 | 2.5E-02 | <0.05 | 5.0E-04 | 1.6E-01 |
| Sc-46 | 5.3E+01 | <0.05 | 2.9E-01 | 3.8E+02 |
| Sn-119m | 2.7E+04 | 0.2 | 2.5E+04 | 3.0E+04 |
| Sr-85 | 2.9E-02 | <0.05 | 1.5E-04 | 2.1E-01 |
| Sr-89 | 4.7E+02 | <0.05 | 2.0E+01 | 2.6E+03 |
| Sr-90 | 4.5E+05 | 3.8 | 1.0E+05 | 1.3E+06 |

**Table S-2.** (continued).

| Radionuclide | Best estimate (Ci) | Percent of total (%) | Lower bound | Upper bound |
|---|---|---|---|---|
| Ta-182 | 8.5E+00 | <0.05 | 3.5E-01 | 4.6E+01 |
| Tc-99 | 2.6E+02 | <0.05 | 1.2E+01 | 1.4E+03 |
| Th-230 | 1.8E-02 | <0.05 | 1.4E-02 | 2.2E-02 |
| Th-232 | 1.3E+00 | <0.05 | 1.1E+00 | 1.6E+00 |
| Tl-204 | 6.7E-04 | <0.05 | 3.2E-06 | 4.8E-03 |
| Tm-170 | 3.4E+00 | <0.05 | 1.6E-02 | 2.4E+01 |
| U-232 | 8.4E+00 | <0.05 | 6.8E+00 | 1.0E+01 |
| U-233 | 1.1E+00 | <0.05 | 7.8E-01 | 1.6E+00 |
| U-234 | 6.4E+01 | <0.05 | 5.0E+01 | 8.2E+01 |
| U-235 | 5.1E+00 | <0.05 | 4.2E+00 | 6.0E+00 |
| U-236 | 2.5E+00 | <0.05 | 1.9E+00 | 3.3E+00 |
| U-238 | 1.1E+02 | <0.05 | 7.0E+01 | 1.8E+02 |
| Y-88 | 2.5E-02 | <0.05 | 5.0E-04 | 1.6E-01 |
| Y-90 | 1.9E+04 | 0.2 | 1.8E+03 | 8.2E+04 |
| Y-91 | 5.3E+02 | <0.05 | 2.2E+01 | 2.9E+03 |
| Yb-164 | 7.6E-03 | <0.05 | 7.4E-05 | 5.3E-02 |
| Zn-65 | 3.6E+02 | <0.05 | 3.8E+00 | 2.5E+03 |
| Zr-93 | 4.0E+00 | <0.05 | 2.4E+00 | 6.4E+00 |
| Zr-95 | 7.6E+04 | 0.6 | 7.0E+04 | 8.2E+04 |
| Total | 1.2E+07 | 99.8[a] | | |

a. Total in table does not equal 100.0% due to rounding.

## Observations and Conclusions

Based on the above results and on knowledge gained in compiling the inventory, the following observations and conclusions are presented:

- The combined use of many types of information sources—process knowledge, operating records, technical calculations, reports, interviews, shipping records, the RWMIS database, and others—was essential to achieve the present degree of completeness of the inventory.

- For radiological contaminants, the inventory information that could be located and that is compiled in the new CIDRA database is believed to be substantially complete.

- For nonradiological contaminants, the inventory information that could be located and that is compiled in CIDRA is also believed to be substantially complete. During the time period of interest, strong emphasis was not placed on documenting the nonradiological hazards in the waste because the current requirements for reporting hazardous chemicals did not exist. However, process information gathered from a multitude of sources has resulted in closing most of the gaps in the shipping records.

- A substantial effort was devoted to breaking down the generic radioactivity terms MAP, MFP, unidentified alpha-emitters, and unidentified beta/gamma-emitters for each generator so that a specific distribution of radionuclides would be available for the risk assessment.

- The predominant (by mass) nonradiological contaminants identified in the waste were as follows: metals—lead, zirconium and its alloys, beryllium, magnesium, sodium-potassium, cadmium, and mercury compounds; organics—carbon tetrachloride, 1,1,1-trichloroethane, trichloroethylene, tetrachloroethylene, and methylene chloride; acids; nitrates and other salts; and asbestos.

- The predominant (by radioactivity at the time of disposal) radiological contaminants identified in the waste were Fe-55, Co-60, H-3, Ni-63, Cr-51, Cs-137, Sr-90, Pu-241, Mn-54, Co-58, Ce-144, and Am-241.

- To confirm its completeness, the compiled inventory of radiological contaminants was compared against the corresponding inventory in the RWMIS database. For the principal radionuclides, the agreement with RWMIS was generally within the total random error of the usual activity-measurement method except for two instances in which the present task developed major new information:

    - The estimated H-3 activity is approximately 20 times larger than the RWMIS value, due primarily to the identification of a major TRA waste stream with approximately 1 million Ci of H-3 entrapped in beryllium.

    - The estimated activities of plutonium and americium radionuclides increased typically by a factor of 10 over the RWMIS values. This result stemmed from an extensive effort to obtain new information on the RFP waste, based on a plant-wide inventory balance at the RFP.

- As an additional confirmation of its completeness, the compiled inventory of radiological and nonradiological contaminants was compared against the inventories in previous reports. The list of contaminants in the new inventory is considerably longer than those in previous inventories. For nearly all contaminants, the new inventory values are similar to or larger than those in previous inventories. Possible exceptions are asbestos, sodium hydroxide, and zirconium, but the methods of estimating quantities of the contaminants vary from study to study.

- As a final confirmation of its completeness, the present inventory of contaminants was compared against the list of contaminants detected in environmental monitoring at the RWMC. No radiological contaminants were reliably detected in the monitoring that had not been identified in the inventory. The only nonradiological contaminants detected more than rarely in the environmental monitoring and not identified in the inventory were three organic compounds: 1,1-dichloroethylene, 1,1-dichloroethane, and dichlorodifluoromethane. These three contaminants may be degradation products or impurities associated with closely related contaminants that were identified in the inventory. Detected contaminants also could have originated from sources other than the subject waste, e.g., in effluents from other INEL facilities or from other waste at the RWMC.

- A large quantity of information was assembled and entered into CIDRA on the physical and chemical forms of the waste streams and of the contaminants, as well as on the packaging of the waste streams.

- Even though the information now residing in CIDRA has been through multiple checks and reviews, the possibility exists for oversights and discrepancies. As new information is discovered, the database will be revised as necessary.

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AEC | U.S. Atomic Energy Commission |
| ALE | Argonne National Laboratory-East |
| ANL-E | Argonne National Laboratory-East |
| ANL-W | Argonne National Laboratory-West |
| ANP | Aircraft Nuclear Propulsion (Program) |
| ARA | Auxiliary Reactor Area |
| ARMF | Advanced Reactivity Measurement Facility |
| ATR | Advanced Test Reactor |
| ATRC | Advanced Test Reactor Critical |
| BAD | Best Available Data (database) |
| BNL | Battelle Northwest Laboratories |
| BORAX | Boiling Water Reactor Experiment |
| BRA | baseline risk assessment |
| BWS | buried waste stream |
| CAS | Chemical Abstract Services |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFA | Central Facilities Area |
| CFR | Code of Federal Regulations |
| CIDRA | Contaminant Inventory Database for Risk Assessment |
| CWS | Chemical Warfare Service |
| D&D | decontamination and decommissioning |
| DOE | U.S. Department of Energy |
| EBR | Experimental Breeder Reactor |

| | |
|---|---|
| ECF | Expended Core Facility |
| EFL | Experimental Fuels Laboratory |
| EPA | U.S. Environmental Protection Agency |
| EPRI | Electric Power Research Institute |
| ETR | Engineering Test Reactor |
| ETRC | Engineering Test Reactor Critical |
| FCF | Fuel Cycle Facility |
| FFA/CO | Federal Facility Agreement and Consent Order |
| FMF | Fuel Manufacturing Facility |
| G-M | Geiger-Müller |
| GCRE | Gas-Cooled Reactor Experiment |
| HDT | historical data task |
| HEPA | high-efficiency particulate air |
| HFEF | Hot Fuel Examination Facility |
| HTRE | Heat Transfer Reactor Experiment |
| ICPP | Idaho Chemical Processing Plant |
| IET | Initial Engine Test (Facility) |
| IFR | Integral Fast Reactor |
| INEL | Idaho National Engineering Laboratory |
| L&O | Laboratory and Office (Building) |
| LLW | low-level waste |
| LOF | Loss-of-Fluid (Test Reactor) |
| LOFT | Loss-of-Fluid Test (Reactor) |
| MAP | mixed activation products |

| | |
|---|---|
| MFP | mixed fission products |
| ML-1 | Mobile Low-Power Reactor No. 1 |
| MTR | Materials Test Reactor |
| NA | not applicable |
| NCP | National Contingency Plan |
| ND | not detected |
| NOS | not otherwise specified |
| NR | not reported |
| NRC | U.S. Nuclear Regulatory Commission |
| NRF | Naval Reactors Facility |
| NRP | Naval Reactors Program |
| NRTS | National Reactor Testing Station |
| OFF | offsite waste generators not otherwise specified |
| PBF | Power Burst Facility |
| PCB | polychlorinated biphenyl |
| PER | Power Excursion Reactor |
| PM | Portable Medium Nuclear Power Plant |
| PQL | practical quantitation limit |
| RCRA | Resource Conservation and Recovery Act |
| RESL | Radiological and Environmental Sciences Laboratory |
| RFP | Rocky Flats Plant |
| RI/FS | remedial investigation/feasibility study |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMF | Reactivity Measurements Facility |
| RML | Radiation Measurements Laboratory |

| | |
|---|---|
| RPDT | recent and projected data task |
| RPSSA | Radioactive Parts Security Storage Area |
| RSD | relative standard deviation |
| RSWF | Radioactive Scrap and Waste Facility |
| RWMC | Radioactive Waste Management Complex |
| RWMIS | Radioactive Waste Management Information System |
| SCMS | Sodium Components Maintenance Shop |
| SDA | Subsurface Disposal Area |
| SL-1 | Stationary Low-Power Reactor No. 1 |
| SLSF | Sodium Loop Safety Facility |
| SNAP | Systems for Nuclear Auxiliary Power |
| SNAPTRAN | Systems for Nuclear Auxiliary Power Transient |
| SPERT | Special Power Excursion Reactor Test |
| SPF | Sodium Process Facility |
| SRE | Sodium Reactor Experiment |
| TAN | Test Area North |
| TMI | Three-Mile Island |
| TRA | Test Reactor Area |
| TREAT | Transient Reactor Test Facility |
| TRU | transuranic |
| TSA | Transuranic Storage Area |
| TSF | Technical Support Facility |
| UCL | upper confidence limit |
| USGS | U.S. Geological Survey |
| VOC | volatile organic compound |

| | |
|---|---|
| WAG | waste area group |
| WMC | Waste Management Complex |
| WRRTF | Water Reactor Research Test Facility |
| ZPPR | Zero Power Physics Reactor |

# REGULATORY SOURCES CITED

## DOE Orders

DOE Order 5820.2A, "Radioactive Waste Management," September 26, 1988

## Codes of Federal Regulation

Code of Federal Regulations, 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Wastes"

Code of Federal Regulations, 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan"

## Statutes

Atomic Energy Act

Clean Air Act

Clean Water Act

Comprehensive Environmental Response, Compensation, and Reliability Act

Federal Water Pollution Control Act

National Environmental Policy Act

Resource Conservation and Recovery Act

Safe Drinking Water Act

Solid Waste Disposal Act

Toxic Substances Control Act

## Agreements

Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory, signed December 9, 1991

# A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1952–1983

## 1. INTRODUCTION AND BACKGROUND

### 1.1 Objective and Overview

This report documents the compilation of a comprehensive inventory of radiological and nonradiological contaminants in waste buried in the Subsurface Disposal Area (SDA) at the Radioactive Waste Management Complex (RWMC) of the Idaho National Engineering Laboratory (INEL) from the opening of the SDA in 1952, through 1983.[a] (This time period is referred to here as the "time period of interest.") The inventory was compiled primarily for performing a future baseline risk assessment (BRA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The project to compile the inventory is referred to as the historical data task (HDT).

A companion report (LITCO 1995) to this report documents the recent and projected data task (RPDT) project. The RPDT project covers waste buried or projected to be buried at the SDA during the years 1984 through 2003. The methodologies used in the two reports are essentially identical. Taken together, the two reports encompass the waste buried or projected to be buried in the SDA from 1952 through 2003.

In terms of disposal location, nearly all of the SDA is included in the inventory. As explained in Section 2 of this report, the SDA consists of numerous disposal units. The disposal units in this task include the pits, trenches, and soil vault rows open during the time period of interest. The inventory includes an acid pit used during the time period of interest and Pad A. Both are located in the SDA. For completeness, the inventory also includes the waste disposed of in Pit 9. The remediation of Pit 9 may be addressed separately, so the Pit 9 inventory may be subtracted later from the total inventory, depending on the detailed scope of the risk assessment.

In terms of specific disposal units, the inventory addresses the following:

- All of the trenches (1 through 58)

- The Acid Pit

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a. The year 1983 was selected as the cutoff point for the portion of the inventory that is reported here based on the following rationale. One particular waste stream (filters from the Waste Calcining Facility at the INEL) that might not have complied with current waste acceptance criteria was disposed of at the SDA as late as 1983. With only a few exceptions, which are described in LITCO (1995), waste disposed of after 1983 complied with the acceptance criteria.

- Pits 1 through 14
- Pits 15 and 16, through 1983
- The 1982 and 1983 waste that is in Pit 17
- Soil Vault Rows 1 through 10, and 12
- Soil Vault Rows 11 and 13, through 1983
- Pad A.

These disposal units form a completely complementary set with those addressed in the companion report (LITCO 1995). Together, the disposal units include all waste disposed of in the SDA.

Waste in the Transuranic Storage Area (TSA) is not included in this inventory because it is stored aboveground.

The inventory addresses radioactive waste, hazardous substances per CERCLA [which encompass hazardous waste per the Resource Conservation and Recovery Act (RCRA) and other hazardous substances], and mixed waste buried in the time period of interest.

Figure 1-1 presents an overview logic flowchart of the activities conducted to develop the inventory.

Several sources of information were used to compile the inventory, including process knowledge, operating logs, previous inventory-related documents, shipping records, information databases, engineering and nuclear physics calculations, and interviews with personnel having knowledge of the facility operations that produced the waste streams.

This task built upon the inventories in previous reports and databases by compiling several types of additional information that are needed for the BRA:

- A more comprehensive inventory of nonradiological contaminants
- Specific radionuclides previously listed under generic names [e.g., mixed fission products (MFP) or mixed activation products (MAP)]
- Physical and chemical forms of the contaminants and of the host waste streams
- Uncertainties in the contaminant quantities.

To confirm its completeness, the inventory was compared with those in other reports and databases, and the reasons for any differences were explored. The list of contaminants was also compared with the list of contaminants detected in environmental monitoring conducted at the SDA.

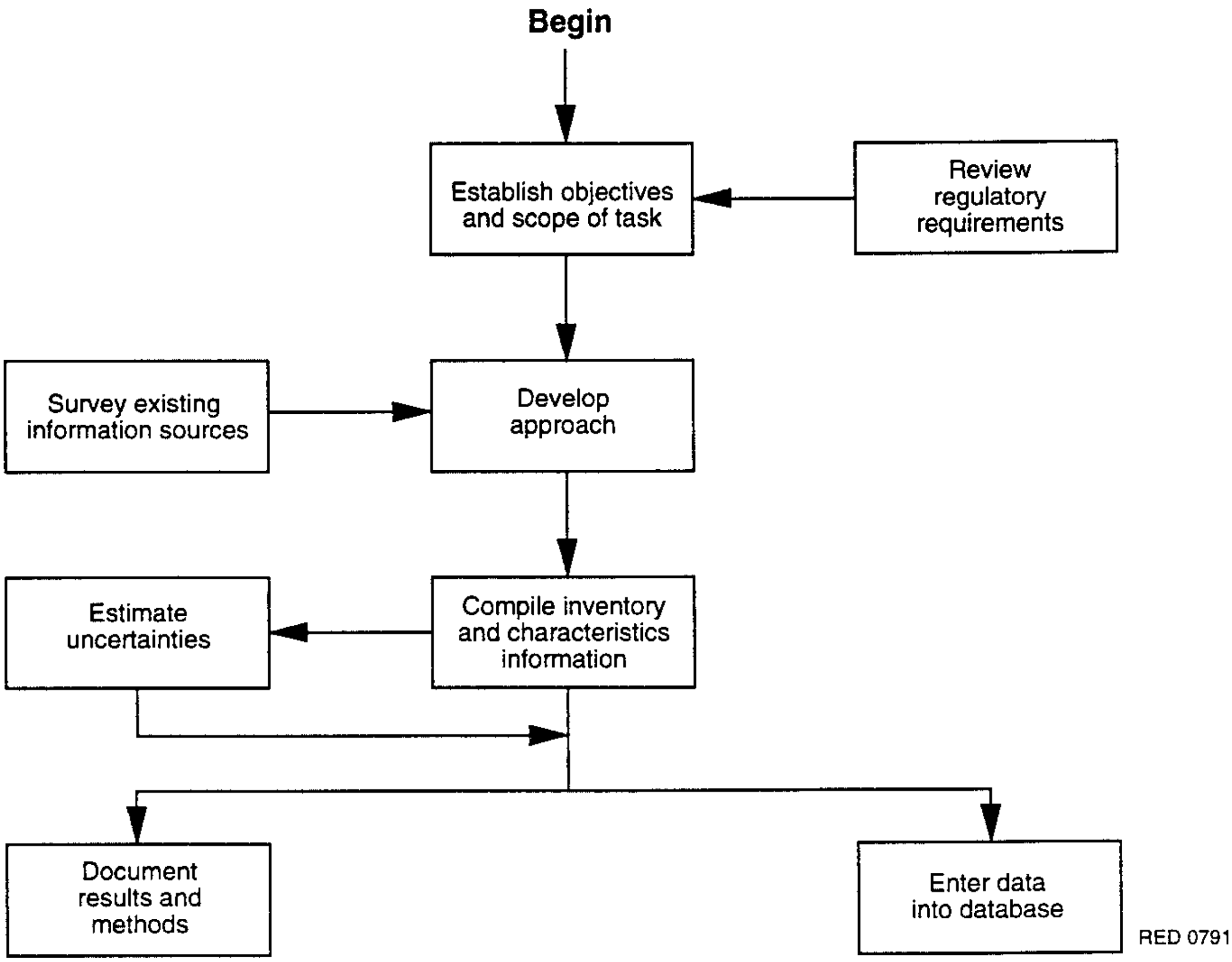


**Figure 1-1.** Overview logic flowchart for the task.

This report is organized as follows. The remainder of this section provides a brief history and description of the SDA, discusses the regulations and regulatory agreements that create the need for the inventory information, and addresses the potential use of the inventory in other applications. The methods used to collect and compile the information are described in Section 2. For the major waste streams from each generator, the specific assumptions and evaluations that were used are also discussed. Section 3 presents the resulting inventory for instances in which the contaminant quantities are known. Section 4 discusses and attempts estimates for instances in which the contaminant quantities are not known. Section 5 discusses the sources of data uncertainty, the methods used to estimate it, and the development of the upper and lower bounds. The completeness of the compiled inventory is confirmed in Section 6 by comparing it with inventories in existing reports and waste information databases and with the environmental monitoring results.

## 1.2 Brief History and Description of the Subsurface Disposal Area[b]

The RWMC, located in the southwest portion of the INEL, is a solid radioactive waste disposal site. The RWMC consists of the 38.85-ha (96-acre) SDA, the 22.7-ha (56-acre) TSA, and the Administrative Area (see Figure 1-2). Because the waste inventoried in this report was disposed of only in the SDA, the other two areas are mentioned only in passing.

The SDA consists primarily of three types of disposal units: pits, trenches, and soil vaults. For regulatory purposes, these disposal units are divided into various operable units, as shown in Figure 1-2.

Development of the SDA began in 1952 on a 5.3-ha (13-acre) tract of the original 40.5-ha (100-acre) site that had been identified for waste management purposes. The first shipment of radioactive waste from the INEL, which at that time was called the National Reactor Testing Station (NRTS), was buried in Trench 1 in the SDA that same year. Today, there is a total of 58 trenches; the last trench was closed in 1982.

Pits were also excavated, starting in 1957, because of the large sizes of some waste items and the increased space efficiency of pit disposal. There is a total of 20 pits in the SDA.

Containers of transuranic (TRU)-contaminated waste from the Rocky Flats Plant (RFP) in Colorado were buried at the SDA beginning in 1954 and ending in 1970. The RFP waste was interspersed with the INEL waste in pits and trenches for several years.

By 1957, the original 5.3-ha (13-acre) SDA was nearly filled. The SDA was then expanded eastward and southward to its present size. The expansion also enclosed the Acid Pit, which had been used since 1954 for the disposal of laboratory acids, some of which contained very low levels of radioactivity. The Acid Pit was officially closed in 1961, although records indicate that it possibly was used once in 1967 and once in 1970.

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b. This section was abridged primarily from the detailed RWMC history presented in *A History of the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory* (EG&G Idaho 1985).

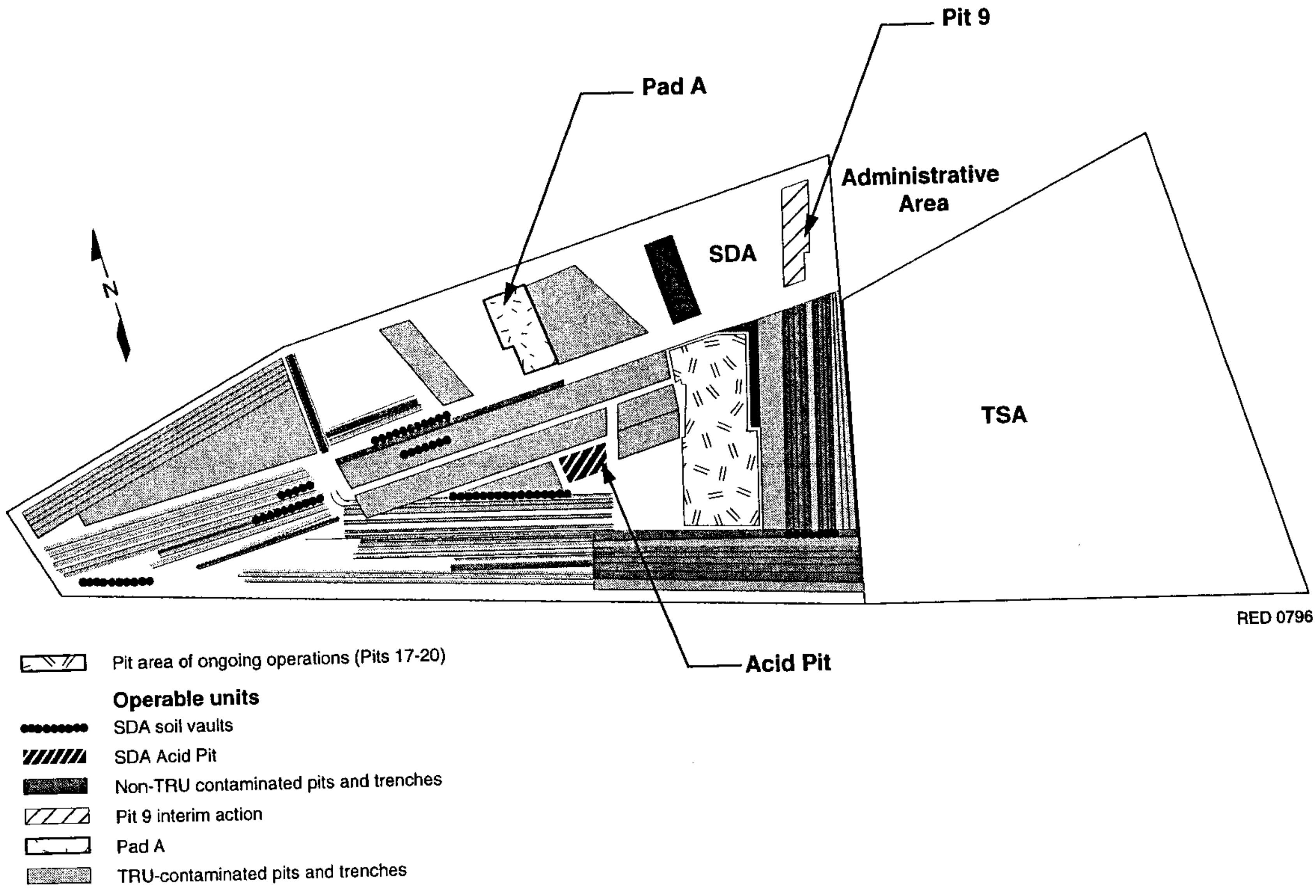


**Figure 1-2.** Overview layout of the Radioactive Waste Management Complex, including the Subsurface Disposal Area, Transuranic Storage Area, and Administrative Area.

Between 1960 and 1963, the SDA also served as an interim burial ground for waste generated by licensees of the U.S. Atomic Energy Commission (AEC) [a predecessor agency to the U.S. Department of Energy (DOE)]. Waste from a number of offsite generators across the country was buried at the SDA during this period. Two additional shipments of non-RFP offsite waste were buried in 1967 and 1969.

Numerous changes in SDA waste management practices took place from 1952 to 1970. The general trend was toward more rigorous disposal practices. Soil-covering frequency, cover thickness, backfill over bedrock before emplacing waste, container designs, and container-stacking practices, as well as waste recordkeeping, evolved and improved over time.

Several flood control and diking projects were completed, beginning in 1958 and continuing into the 1980s. Most of these projects were in response to flooding of the SDA by local runoff from snowmelt in 1962, 1969, and 1982.

In 1970, the AEC issued a policy requiring the segregation of waste contaminated with TRU radionuclides and the storage of that waste in a mode permitting later retrieval of contamination-free containers. A decision was made at the RWMC to store and cover future receipts of TRU waste[c] (and suspected TRU waste) aboveground. Accordingly, burial of such waste at the SDA ceased in 1970. Burial of non-TRU waste [low-level waste (LLW)] continues. The 22.7-ha (56-acre) TSA was established at the RWMC in 1970 for aboveground storage of newly received TRU waste, thereby expanding the RWMC to its present size.

In 1972, Pad A was established in the SDA for aboveground disposal of waste suspected of containing TRU radionuclides but in concentrations less than 10 nCi/g. Pad A was closed in 1978.

Two programs demonstrated experimental retrieval of part of the waste buried in the SDA. The Initial Drum Retrieval Program (1974 through 1978) and the Early Waste Retrieval Program (1976 through 1978) retrieved approximately 4,248 $m^3$ (150,000 $ft^3$) of waste, which was placed on the

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c. The current definitions of TRU waste and LLW are as follows, as stated in DOE Order 5820.2A:

***Transuranic waste***—Without regard to source or form, waste that is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay.

***Low-level waste***—Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, or spent nuclear fuel or 11e(2) byproduct material . . . Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided that the concentration of transuranics is less than 100 nCi/g.

Before 1984, the lower limit of transuranic radionuclide activity for defining TRU waste was 10 nCi/g, rather than the currently specified 100 nCi/g.

Much of the LLW and TRU waste disposed of in the SDA during this period is **mixed waste**: waste containing both radioactive and hazardous chemical components as defined by the Atomic Energy Act and RCRA, respectively.

TSA-R storage pad in the TSA and on Pad A. The waste retrieved in these programs has not been subtracted from the inventory developed in this report, but it will be subtracted before preparing the BRA.

In 1977, the use of soil vaults for the disposal of high-radiation-level waste began in the SDA. Soil vaults eventually replaced trenches for the disposal of such waste. The vaults are drilled in rows, as shown in Figure 1-2. As of this writing, final preparations are underway to dispose of future high-radiation-level LLW in concrete vaults placed in pits.

In 1980, disposal of LLW from Argonne National Laboratory-East (ANL-E) in Illinois began at the SDA. Disposal of LLW from that generator ceased in 1988.

## 1.3 Pertinent Regulations and Agreements

This section describes the regulatory framework under which this task was performed.

Under CERCLA (or Superfund) of 1980, as amended, Federal agencies that have facilities included on the U.S. Environmental Protection Agency's (EPA's) National Priorities List are required to enter into agreements with the EPA. These interagency agreements are designed to expedite remedial actions in response to the release (actual or potential) of hazardous substances to the environment at those facilities.

On December 21, 1989, the INEL was added to the EPA's National Priorities List of Superfund sites. On December 9, 1991, a Federal Facility Agreement and Consent Order (FFA/CO) for the INEL was signed and approved by DOE, EPA, and the State of Idaho Department of Health and Welfare. The goal of this agreement is to ensure that INEL releases of hazardous substances are thoroughly investigated in accordance with the National Contingency Plan (NCP) (see 40 CFR 300) and that appropriate response actions are taken as necessary to protect human health and the environment. One of the INEL waste area groups (WAGs) defined under the FFA/CO is WAG-7, the RWMC.

Under 40 CFR 300.430 (d)(2), the NCP requires that

> "The lead agency shall characterize the nature of and threat posed by the hazardous substances and hazardous materials and gather data necessary to assess the extent to which the release poses a threat to human health or the environment . . ."

The HDT and the RPDT (LITCO 1995) focused on the first part of this regulation, i.e., ". . . characterize the nature of . . . the hazardous substances and hazardous materials . . "[d] disposed of in the SDA. The BRA that this task supports will address the second portion of the requirement.

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d. Generally throughout this report, the term "contaminants" is used in place of "hazardous substances and hazardous materials."

More detailed requirements concerning the characterization of hazardous substances are found in 40 CFR 300.430 (d)(2) (iii) and (iv). The information collected is to cover

> ". . . the general characteristics of the waste, including quantities, state, concentration, toxicity, propensity to bioaccumulate, persistence, and mobility" and "the extent to which the source can be adequately identified and characterized."

The HDT and the RPDT (LITCO 1995) addressed most of the above requirement. The remainder of the requirement will be addressed in the BRA.

Guidance on complying with the NCP regulations is provided in, among other sources, the *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part A* (EPA 1989). Section 4 of that manual lists "determination of the nature of the wastes" as one of the primary data-collection components of the remedial investigation/feasibility study (RI/FS) conducted under the NCP. Available site information must be reviewed, including "information on amounts of hazardous substances disposed (e.g., from site records)."

The HDT was planned and conducted with close attention to the above regulations and guidance. The intent was that the resulting inventory of contaminants comply fully with all applicable requirements.

## 1.4 Other Uses of the Results

In addition to its use for the BRA, the inventory information has other potential uses. Much of the present information may be useful for evaluating remedial alternatives. The information collected on chemical and physical properties of the waste may be helpful in evaluating treatment alternatives, assessing health and safety hazards to workers, and identifying potential operational problems.

**Caution:** Other applications of this information may be appropriate only if the nature of the application is compatible with the purpose of this study. This information (which was developed for risk assessments under CERCLA) may not be suitable for use in other applications. For example, the degree of conservatism appropriate in inventory information depends on the application. For some applications, best-estimate values are appropriate. For other applications, more conservative values are appropriate. In evaluations such as safety analyses, highly conservative, upper-limit values are generally appropriate.

Although a major effort has been devoted to compiling this inventory, new information may be identified that could require modifying the inventory. Furthermore, some information concerning certain contaminants may never be located because of the lack of records.

## References for Section 1

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